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NUCLEAR WASTE

DOE's Handling of Hanford Reservation Iodine Information



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May 25, 1988

The Honorable Mark O. Hatfield
United States Senate

The Honorable Ron Wyden
House of Representatives

The Honorable Al Swift
House of Representatives

In response to your requests, this report discusses the Department of Energy's handling of information on detection of radioactive iodine below the surface of the Hanford nuclear reservation in southeast Washington. Specifically, the report discusses, among other things, why the Department did not release the information before August 1987 and the effect the information might have had on the selection of Hanford as a candidate nuclear waste repository site, had it been released earlier.

As agreed with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to the Secretary of Energy, other committees and Members of Congress, and other interested parties. Copies will be made available to others upon request.

This work was performed under the direction of Keith O. Fultz, Senior Associate Director. Other major contributors are listed in appendix I.

J. Dexter Peach
Assistant Comptroller General

Executive Summary

Purpose

In August 1987 the Department of Energy (DOE) released information showing the presence of Iodine-129, a radioactive material, in groundwater beneath its Hanford Reservation in southeastern Washington State. The information raised serious questions about the reservation's suitability as a candidate site for a nuclear waste repository. Concerned about why the information had not been disclosed in a May 1986 environmental assessment, Senator Mark Hatfield and Representatives Ron Wyden and Al Swift requested GAO to, among other things,

- provide information on why DOE did not release Iodine-129 information until after Hanford had been selected as a candidate site and
- assess the effect the information might have had on the repository site-selection process had it been considered when the environmental assessment was being prepared.

Background

The Nuclear Waste Policy Act of 1982 established a comprehensive national program for developing deep underground repositories to safely isolate highly radioactive nuclear waste. The act required the Secretary of Energy to nominate potential sites and prepare an environmental assessment for each nominated site. Until December 1987, Hanford was one of three sites under consideration for permanent disposal of the nation's high-level nuclear waste. In December, the Congress directed that the number of sites under active evaluation be reduced to one—Yucca Mountain, Nevada. The evaluation of Hanford had proceeded to the point, however, where a number of concerns had been raised about the adequacy and completeness of information being used to judge the site's acceptability as a waste repository.

Repository siting guidelines specify technical considerations that must be satisfied for a site to be acceptable. They also contain disqualifying conditions, such as groundwater moving from a repository zone and thus providing a possible pathway for radioactivity to reach the accessible environment in less than 1,000 years.

Because Iodine-129 is soluble in water and can be detected in extremely small quantities, it is a good tracer for detecting the movement of water from liquid waste disposal sites into surface and subsurface water and for detecting leaks at repository sites. Iodine-129 is contained in the liquid wastes produced from atomic energy defense activities at Hanford. Therefore, detection of abnormally high levels of Iodine-129 well beneath the surface of Hanford could provide useful information on the movement of groundwater and radioactive material.

Results in Brief

DOE's handling of information on Iodine-129 detected in Hanford groundwater was dominated by a pattern of activity that generally discouraged disseminating the information within and outside the agency. This pattern of activity was so pervasive that, in GAO's view, DOE might never have publicly released the information if the Nuclear Regulatory Commission, through its on-site representative, had not identified and pursued the issue.

DOE maintains that available information regarding Iodine-129 migration is insufficient to disqualify Hanford from consideration; addressing it in the environmental assessment would not have affected its selection of Hanford as a candidate repository site. The Commission and Washington State generally agree that not enough is known about the Iodine-129 migration issue to have rejected Hanford on that basis.

Principal Findings

Studies Not Well Coordinated

GAO found little coordination in the study of Iodine-129 at Hanford. In the past 2 decades, numerous studies aimed at determining the migration of radionuclides, including Iodine-129, were conducted. Wells were drilled, water samples were collected and analyzed, and data were compiled. However, field records for drilling and sampling activities and for data bases were scattered among individuals, program libraries, and drilling contractors. Numerous activities and publications were started but not completed and little evidence existed of integrated planning. Few reports about Iodine-129 studies were written and even fewer were published.

Concerns Over Security and Other Issues

Concerns about security, whether real or perceived, played a role in the nondisclosure of Iodine-129 information. Considerable uncertainty existed among DOE's contractors on whether Iodine-129 information was classified. Much of the information, especially from the earlier years of Hanford operations, was originally classified. Even though DOE subsequently declassified many of the documents, declassification had little effect on making them more generally available. Several officials, apparently unsure about what could be disclosed, took a very cautious approach, even as far as not disclosing the information to contractors working at Hanford in the repository program.

Also, most unclassified documents were cataloged in a location that required a security clearance for access. Few of the declassified documents have been listed in the data bases or information retrieval systems available to the public.

Concerns about other issues also affected the availability of Iodine-129 information, such as (1) the public's reaction to information that might be perceived to impact the environment and/or public health and safety and (2) the effect the release of such information might have on Hanford as a potential repository site. These concerns were implicit in the pattern of activity GAO found. (See ch. 2.)

DOE Position on Iodine-129 Information

DOE made almost no use of Iodine-129 information in its Hanford environmental assessment. DOE officials at Hanford said they did not use this information primarily because, as a matter of policy, information that has not been published or made readily available to the public is generally not included in such an assessment. DOE headquarters officials, however, were unaware of any such policy. Nonetheless, now that the Iodine-129 information has been compiled and analyzed, DOE maintains that its conclusions, as set forth in the May 1986 environmental assessment, would not change. In this regard, detailed site studies to confirm Hanford's suitability will not be conducted now that it has been eliminated as a candidate repository site.

Commission and State Views

Nuclear Regulatory Commission officials said that a definitive judgment cannot be made on the appropriateness of Hanford as a repository site because of currently limited data. According to the state of Washington, the environmental assessment omitted significant information on Iodine-129, and its conclusions on the distribution of iodine at Hanford were misleading. The state has also concluded, however, that additional study is needed to fully evaluate the issue of groundwater movement at Hanford.

Recommendations

This report assesses DOE's handling of information on Iodine-129 contamination at Hanford in relation to the possibility of developing a nuclear waste repository at the site. Because the site is no longer under consideration for a repository, the report contains no recommendations.

Agency Comments

GAO obtained and incorporated the views of responsible DOE officials on this report. As requested, GAO did not obtain DOE's official comments on the report.

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Abbreviations

ARHCO	Atlantic Richfield Hanford Company
AEC	Atomic Energy Commission
BWIP	Basalt Waste Isolation Project
CASP	Combined Aquifer Sampling Program
DOE	Department of Energy
ERDA	Energy Research and Development Administration
GAO	General Accounting Office
NRC	Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act of 1982
PNL	Pacific Northwest Laboratory

Introduction

The Hanford reservation, a facility owned by the Department of Energy (DOE), covers 570 square miles of southeastern Washington State. Established in 1943 to produce plutonium for nuclear weapons, Hanford currently is the site for a number of energy-related activities, including the production of nuclear material for national defense programs and energy research and development.

Until December 1987, Hanford was one of three sites under consideration for permanent disposal of the nation's high-level nuclear waste. In December, the Congress directed that the number of sites under active evaluation be reduced to one—Yucca Mountain, Nevada. The evaluation of Hanford had proceeded to the point, however, where a number of concerns had been raised about the adequacy and completeness of information being used to judge the site's acceptability as a waste repository. DOE is confident that its investigation of the Yucca Mountain site will show that it is suitable for a repository. If, however, DOE's evaluation of the Nevada site should lead it to determine that the site is not suitable, the Congress will have to address, once again, the issue of where to locate a repository. It is possible that Hanford would, at that point, be reconsidered.

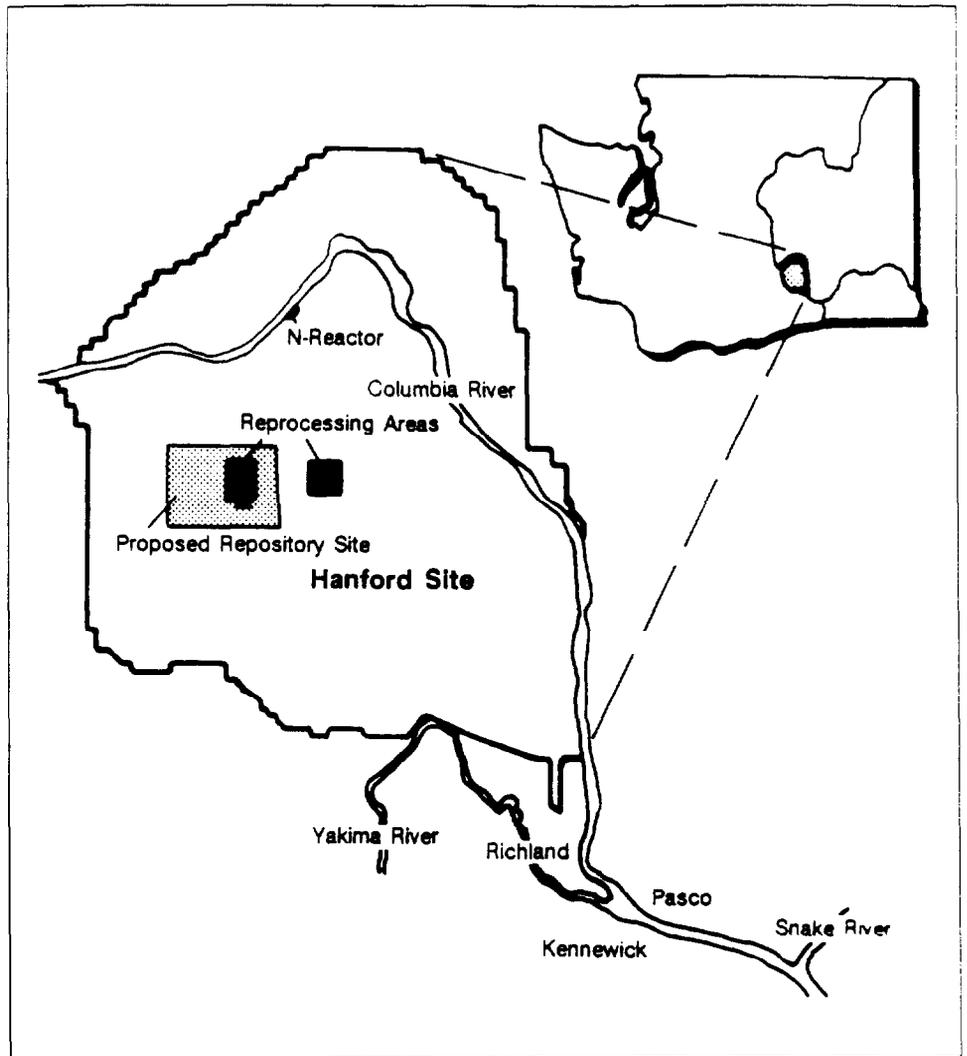
One of the concerns raised about Hanford dealt with information about Iodine-129 (I-129) released by DOE in August 1987. I-129 is a radioactive form of iodine. It occurs to a limited extent in nature, but it is also a by-product of man-made nuclear fission. Iodine-129 is extremely long-lived, with a half-life of 16 million years (the time needed for half of the radioactivity to decay) and is a useful "tracer" for observing the movement of groundwater. DOE's August 1987 disclosure that concentrations of I-129 had been detected in Hanford groundwater have raised questions about the movement of radioactive material from the proposed repository to the accessible environment and thus about the site's suitability for permanent storage of nuclear waste.

Overview of the Hanford Reservation

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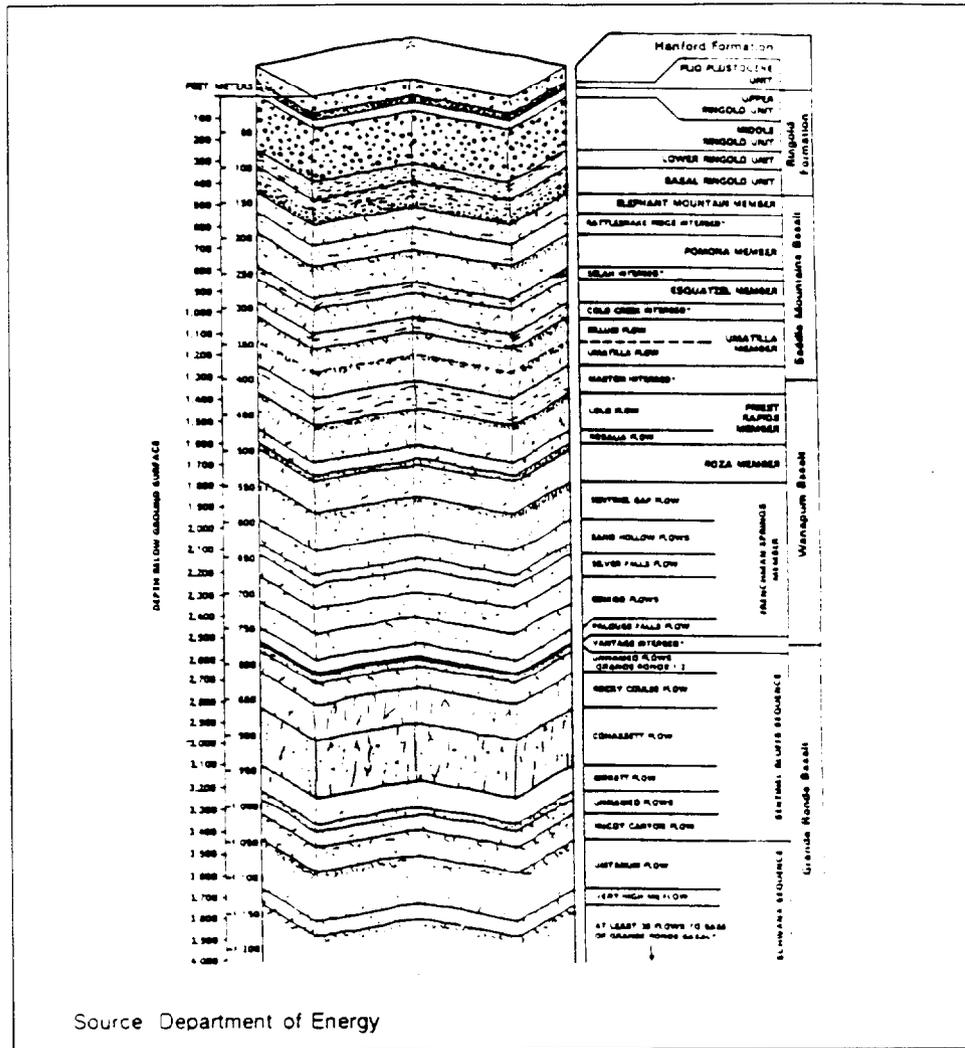
Hanford is located on a desert plain where the rainfall averages about 6.3 inches a year. The Columbia River flows through the northern part of the reservation and forms part of its eastern boundary, and the Yakima River touches a portion of the southern boundary. The nearby cities of Richland, Pasco, and Kennewick, with a combined population of about 144,000, are situated downstream on the Columbia River. (See fig. 1.1.)

Figure 1.1: DOE's Hanford Site in Washington State



The geology of the Hanford reservation is one of layers of basalt, a dense, fine-grained volcanic rock created from lava flows that covered the area. As figure 1.2 shows, there are many such layers. Groundwater aquifers are also found beneath the reservation. Some of these aquifers are confined—that is, the groundwater is bounded above and below by relatively impermeable rocks. The uppermost aquifer is unconfined—it has no relatively impermeable upper barrier.

Figure 1.2: Cross-Section of Basalt Layers at the Hanford Site



Source: Department of Energy

In 1943, the U.S. Army Corps of Engineers selected the Hanford site as the location for facilities to produce plutonium during World War II. By mid-1955, eight production reactors were operating. Since 1971, only one reactor (the N-reactor, which was started up in December 1963) has been in operation. The reservation also contains other facilities where plutonium is recovered from irradiated reactor fuel, processed, and shipped off-site for additional processing and eventual use in nuclear weapons.

Processing and Monitoring of Nuclear Waste

The processing of nuclear materials at Hanford has generated large amounts of radioactive waste. Of the several types of nuclear waste generated at Hanford, high-level waste remains dangerous for hundreds of years and must be handled behind protective shielding. Hanford generates high-level liquid waste from reprocessing spent (used) nuclear fuel. The liquid waste is stored on an interim basis in large underground tanks. DOE reported in 1986 that Hanford had about 61.4 million gallons of high-level waste in storage. Hanford also has some solid high-level waste, which is stored on an interim basis in capsule form inside steel-lined concrete water basins. Hanford does not have facilities for long-term or permanent storage of this high-level waste; however, scientists and engineers are developing ways to permanently dispose of radioactive waste generated by the defense production activities at Hanford. The wastes will be retrieved from the tanks, converted into a solid glass, and sent to a waste repository. Work also is being done on a process that mixes low-level radioactive waste with a cement-like material called grout.

Intermediate-level and low-level wastes contain lesser degrees of radioactivity. Much of this waste consists of trash—tools, paper, rags, and glassware, for example—or water circulated through various facilities for cooling. Such waste has been generated since the facility opened in 1943. Over the years, the contaminated water has been disposed of directly to the soil through ponds, trenches, ditches, and the like, and the solid waste has been buried in shallow pits or trenches. We reported earlier¹ that Hanford officials estimated that Hanford would generate about 850,000 cubic feet of solid low-level waste and about 1.4 billion gallons of radioactively contaminated liquid low-level waste in 1986.

Hanford conducts a wide-ranging program of environmental monitoring to assess effluent impacts and to detect whether nuclear wastes are escaping from their containment. At Hanford, the primary pathways available for radioactive materials and chemicals to move from Hanford operations to the public are the atmosphere, surface water, and groundwater. Current activities to monitor these pathways and the remainder of the environment are conducted by DOE's contractor organizations. The criteria set forth for environmental monitoring are derived from requirements in applicable federal, state, and local regulations. To demonstrate compliance with applicable rules and regulations, results are supposed to be reported to regulatory agencies and to the public

¹Nuclear Waste: Unresolved Issues Concerning Hanford's Waste Management Practices (GAO RCED-87-30, November 1986).

Hanford as a Nuclear Waste Repository Site

For more than 20 years, DOE and its predecessor agencies have investigated Hanford's suitability for long-term, high-level nuclear waste storage. Figure 1.3 summarizes the key dates for these studies and for Hanford's main production activities. Through the early 1970s, these studies focused on disposal of wastes generated at Hanford. Since then, the study efforts have expanded to exploring Hanford's feasibility as a regional or national site for nuclear waste.

Early Studies and Programs for Waste Disposal

At the request of the Atomic Energy Commission (AEC)² in 1955, the National Academy of Sciences initiated a feasibility study for disposal of high-level radioactive wastes on land within the continental limits of the United States. For several years, this program focused primarily on the suitability of other types of geologic formations than the basalt underneath Hanford. By the mid-1960s, however, concern had grown that several of the main alternatives under study were unsuitable, and the National Academy of Sciences recommended that detailed geologic investigations at Hanford be conducted to determine the feasibility of constructing underground storage tunnels in basalt for the disposal of solid nuclear wastes. The Academy also recommended that an existing 10,655-foot borehole located at the southwestern boundary of the Hanford site be re-entered.

As a result of the information obtained from the deep borehole, funding was provided to drill several deep boreholes in the Hanford site to further characterize the underlying basalt rock. As part of this study, four deep boreholes greater than 3,500 feet deep were drilled, and limited hydrologic tests were conducted within the Hanford site in the late 1960s.

²On January 19, 1975, the part of AEC responsible for radioactive waste became part of the Energy Research and Development Administration, which became DOE on October 1, 1977.

Figure 1.3: Timeline of Production and Waste Site Events at Hanford

Production Events	Waste Site Events
<p>1943 Site established 1944 First reactor operating</p>	
<p>1955 Eight reactors operating</p>	<p>1955 Feasibility study for high-level waste site requested by Atomic Energy Commission</p>
<p>1963 N-reactor starts operating</p>	<p>Mid-1960s Feasibility study recommends Hanford for further consideration as a site; evaluation work continued</p>
<p>1971 Original eight reactors closed; N-reactor and chemical processing plants continue in operation</p>	<p>1976 National Waste Terminal Storage Program begun (regional repositories) 1977 Basalt Waste Isolation Program begun</p>
	<p>1983 Nuclear Waste Policy Act of 1982 passed, nine potential sites identified 1984 Environmental assessments drafted 1985 Nuclear Regulatory Commission comments on environmental assessments; additional comments address I-129 1986 Final environmental assessments issued, three sites recommended and approved 1987 Legislation passed eliminating Hanford as a potential site for the repository</p>

National Waste Terminal Storage Program

In 1976, radioactive waste management programs were expanded and the National Waste Terminal Storage Program was established. This

program included identifying potential repository sites in several different types of geologic rock. The program called for research and development to support design, licensing, construction, operation, and decommissioning of a repository. The goal of the program was to establish a system of regional repositories to dispose of high-level and medium radioactive nuclear wastes generated by commercial power reactors and un-reprocessed spent fuel.

Basalt Waste Isolation Project

In 1977, DOE established the Basalt Waste Isolation Project (BWIP) at Hanford as part of a restructuring and expansion of the National Waste Terminal Storage Program. The BWIP mission was to identify potential geologic repository sites in basalt within the Hanford site, to design the facilities associated with such a repository, and to develop technology required for the permanent isolation of radioactive wastes in basalt formations. Two main factors led to Hanford's selection. The first was Hanford's location atop the approximately 50 basalt layers that compose the Columbia River Basalt Group. This type of rock was considered a good candidate for long-term underground storage of nuclear waste. The second factor was Hanford's availability—it was a federally owned area that had already been committed to nuclear activities for more than 30 years.

Between 1977 and 1982, DOE and its predecessor agencies studied the feasibility of disposing of high-level wastes in basalt and the technology needed to design and construct waste packages and a repository in such a medium. In 1978, an effort began to identify a possible location for the repository so that design studies and planning for testing could proceed on the basis of a single location in the basalt. Various selection criteria were applied and a number of boreholes were drilled from which data were obtained.

Nuclear Waste Policy Act of 1982

DOE's activities at Hanford were affected by passage of the Nuclear Waste Policy Act of 1982 (NWPA). The act established a federal policy for nuclear waste management and a timetable for ensuring the safe storage and disposal of the nation's nuclear waste. It provided for activities that would lead to selecting two sites for deep-underground repositories and for constructing and operating the first such repository.

The act required DOE to develop general guidelines for recommending sites. These guidelines, which received concurrence of the Nuclear Regulatory Commission (NRC), were published in December 1984. They specify, for the various technical considerations to be taken into account, the conditions that must be satisfied for a site to be considered acceptable and the conditions that would eliminate a site from consideration. The guidelines contain 17 disqualifying conditions. For example, a site would be disqualified if groundwater from the zone of the planned repository could be expected to bring significant amounts of radioactivity to the "accessible environment"³ in less than 1,000 years.

The act also required the Secretary of Energy to nominate as candidates for the first repository at least five sites considered suitable for more detailed geologic testing or site characterization⁴ and to recommend three of the five sites to the President for such additional work. The act also required DOE to prepare an environmental assessment for each site nominated as a potential repository site. The assessments, which were to be based on available earth sciences and other information, were to present a detailed statement of the basis for nominating each site and recommending these sites for site characterization, including an evaluation of the suitability of the site for characterization under the siting guidelines.

When the act was passed, DOE was trying to finalize its selection of sites for the first repository and had begun regional surveys for the second repository. While NWPA did not prohibit DOE from continuing any ongoing or planned site characterization, it did require that certain conditions be met before proceeding with such a program. Its initial impact at Hanford was to postpone further site characterization activities until siting guidelines had been prepared, environmental assessments had been completed, and sites had been formally nominated and recommended.

DOE folded its consideration of Hanford into the larger process called for under NWPA. After considering various sites, DOE picked Hanford as one of the three sites it would recommend for characterization. The two

³The term accessible environment means the atmosphere, land surfaces, surface waters, oceans, and the subsurface beyond a specified distance from the proposed repository.

⁴The act defines site characterization primarily as "... activities, whether in the laboratory or in the field, undertaken to establish the geologic condition and the ranges of the parameters of a candidate site relevant to the location of a repository, including borings, surface excavations, excavations of exploratory shafts, limited subsurface lateral excavations and borings, and in-situ [in-place] testing needed to evaluate the suitability of a candidate site for the location of a repository ..."

others were Deaf Smith County, Texas, and Yucca Mountain, Nevada. The President approved the three for characterization on May 28, 1986.

Study of the suitability of the Hanford site was halted by the Congress in December 1987. In the Nuclear Waste Policy Amendments Act of 1987 (enacted as a part of the Budget Reconciliation Act for Fiscal Year 1988, P.L. 100-203), the Congress directed that site characterization activities at Hanford and at the Deaf Smith County site be stopped within 90 days after the date of enactment. Under the terms of the amendments, all site characterization work was then to focus on the site at Yucca Mountain, Nevada. Unless the site characterization work disclosed reasons to disqualify Yucca Mountain, the repository site is to be located there. The act also terminated activities for identifying a second repository site.

The Significance of Iodine-129

Iodine-129 is a useful "tracer" for observing the movement of groundwater. It dissolves easily in water and is not readily absorbed in the soil. It is an extremely long-lived radioactive material, and its radioactivity can be detected at levels far below the maximum permitted by the Environmental Protection Agency for drinking water. It occurs in nature, where its principal sources are natural uranium deposits and cosmic-ray reactions, but it is also produced by nuclear weapons testing and nuclear fuel reprocessing. Detecting I-129 at higher-than-natural levels in groundwater samples may serve, together with other factors, as an indication that aquifers may be interconnected and provide a potential method for measuring the movement of radioactive materials from the proposed repository to the accessible environment.

Analysis of Hanford Groundwater for I-129

I-129 was not a part of the first 20 years of environmental monitoring and testing at Hanford. Ways to accurately detect discrete isotopes such as I-129 were not developed until the late 1950s and early 1960s. In fact, the first I-129-related collection of groundwater samples at Hanford, conducted in 1962, was done to develop I-129 analytical methods. By the mid-1970s, most of the technology for accurate detection of I-129 had been developed. Today, the technology is in place to routinely separate and measure I-129 at its natural (at Hanford, pre-1944) level.

Specific analyses of I-129 at Hanford are discussed more fully in chapter 2. Most of the testing done for I-129 at Hanford has been part of a general environmental monitoring, not part of the testing focused on assessing Hanford's suitability as a long-term waste disposal site. The first extensive program for groundwater sampling of I-129 in the unconfined

aquifer began in 1971. Also in the early 1970s, wells were drilled and I-129 samples were taken from the confined aquifer system because of a perceived concern for potential off-site migration of radioactive materials. I-129 testing has continued into the 1980s as well.

In 1986, a working group of DOE contractor personnel was formed to gather, summarize, and evaluate all information available on I-129. In August 1987, the group released its final report. Among other things, the report disclosed that I-129 had been detected in confined aquifers 1,500 feet below the surface at higher concentrations than would be expected in the natural environment. The proposed location for the repository at Hanford, a basalt layer some 3,000 feet below the ground, was much further down, but its suitability as a repository site depended in part on being able to demonstrate that groundwater in that layer could not migrate to the accessible environment in less than 1,000 years.

The presence of I-129 in the groundwater beneath Hanford raised questions about the suitability of the proposed Hanford site as a permanent waste storage repository. Also of concern was the disclosure that DOE had not released information about I-129 to the public nor referenced the information in its May 1986 environmental assessment. DOE concluded in this assessment that Hanford was a suitable finalist for further study as a permanent repository site.

Objectives, Scope, and Methodology

In a letter dated August 7, 1987, Senator Mark Hatfield, Ranking Minority Member, Senate Appropriations Committee, asked us to review several aspects of the I-129 issue at the Hanford Nuclear Reservation. Subsequently, on August 20, 1987, Representatives Ron Wyden and Al Swift requested that we review similar aspects pertaining to the I-129 issue. On the basis of discussions with representatives of these Members of Congress, our objectives were to

- provide information that would indicate why DOE did not release studies and reports on I-129 until after Hanford had been selected as a candidate site,
- assess the impact on the repository site-selection if the I-129 reports had been considered while preparing Hanford's environmental assessment or any other materials related to the decision, and
- describe and assess current DOE groundwater studies at Hanford.

Most of our field work was conducted in Richland, Washington, the site of the Hanford Nuclear Reservation. During our review, we interviewed

DOE and DOE contractor managers and staff, and former contractor managers who had been involved in BWIP, or who could provide us with information about the issues receiving congressional concern. We attended weekly BWIP meetings and interviewed officials of DOE's Office of Inspector General, NRC, the U.S. Bureau of Mines, the U.S. Geological Survey, affected Indian tribes, and the state of Washington.

We examined numerous memoranda, letters, reports, and technical documents such as the NWPA, the Hanford environmental assessment and draft site characterization plan, and the I-129 report produced by the intercontractor working group. We also reviewed the I-129 documents provided by DOE to the state of Washington and affected Indian tribes.

In addition, we examined a number of classified and declassified documents at the Pacific Northwest Laboratory (PNL) technical library. These documents had been identified to us as containing information relating to I-129.

We conducted our field work between August 1987 and February 1988. Our review was conducted in accordance with generally accepted government auditing standards.

We met with officials at DOE's Richland Operations Office to obtain their comments on the facts presented in this report, and we made minor clarifications to the report on the basis of the comments they provided to us. Subsequently, we provided a statement of the facts discussed in the report to officials at DOE headquarters for their review. They stated that the statement of facts fairly represented the I-129 issue. As requested, we did not ask DOE to review and comment officially on the report.

DOE Not Diligent in Assuring That Issues Involving Iodine-129 In Hanford Groundwater Were Resolved and Disclosed

The recent disclosures of documents prepared up to 30 years ago on the detection of Iodine-129 (I-129) in groundwater beneath the Hanford Reservation raises questions about both the site's suitability as a nuclear waste repository and why DOE did not disclose the information earlier in the draft and final environmental assessments. We found no evidence to indicate any improper motive on the part of DOE or its contractors in withholding the information; however, we found a pattern of activity regarding the handling of information on I-129 that discouraged its dissemination within the larger DOE community at the Hanford Reservation and its placement in the public domain. This pattern of activity was so pervasive that, in our view, it is unlikely that DOE would have publicly released the I-129 information if NRC, through its on-site representative, had not identified and pursued the issue.

DOE states that forthright treatment of the I-129 issue in the environmental assessment would not have altered its selection of Hanford as a candidate repository site. According to DOE, available information regarding I-129 migration is insufficient to disqualify Hanford from consideration, and thus would not have affected the site-selection. Both NRC and the state of Washington generally agree that not enough is known, even now that the I-129 documents have been released, to eliminate Hanford from consideration on that basis.

I-129 Studies and Reports at Hanford

Before considering the events and issues surrounding disclosure of I-129 information at Hanford, it is important to understand what studies and reports have been done on I-129. The timeline illustrated in figure 2.1 shows the I-129 studies and reports done at Hanford, together with the nuclear materials production and nuclear waste site events discussed in chapter 1. As figure 2.1 shows, studies on I-129 began in the late 1950s and continued through the 1980s. Few reports about I-129 studies were written and even fewer were published. For example, one report on analysis of water samples between 1962 and 1974 was drafted in 1975 but was not released by DOE as a formal draft until December 1986. Confined Aquifer Sampling Program (CASP) reports on wells drilled during the 1970s were not completely published until August 1987. Field records for drilling and sampling activities and for data bases were scattered among individuals, program libraries, and drilling contractors.

Chapter 2
DOE Not Diligent in Assuring That Issues
Involving Iodine-129 in Hanford Groundwater
Were Resolved and Disclosed

Figure 2.1: Timeline of I-129 Studies and Reports in Relation to Production and Waste Site Events

Production Events	I-129 Studies and Reports	Waste Site Events
<p>1943 Site established 1944 First reactor operating</p>		
<p>1955 Eight reactors operating</p>	<p>Late 1950s-early 1960s Work on I-129 detection equipment and laboratory methods development</p>	<p>1955 Feasibility study for high-level waste site requested by Atomic Energy Commission</p>
<p>1963 N-reactor starts operating</p>	<p>1962 Groundwater first sampled for I-129 environmental analysis 1962-65 Preliminary analysis of on-site groundwater conducted 1966 Analysis of off-site groundwater begun; on-site and off-site analysis continued on selected basis to 1975</p>	<p>Mid-1960s Feasibility study recommends Hanford for further consideration as a site; evaluation work continued</p>
<p>1971 Original eight reactors closed; N-reactor and chemical processing plants continue in operation</p>	<p>1972 Report issued on sampling for I-129 during 1962-68 1975 Draft report prepared on sampling for I-129 during 1962-74 1975 Confined aquifer sampling program begun 1976 Atlantic Richfield Hanford Company Technology Program Plan revised and updated</p>	<p>1976 National Waste Terminal Storage Program begun (regional repositories) 1977 Basalt Waste Isolation Program begun</p>
<p>1980 Confined aquifer sampling program completed</p>	<p>1980 Confined aquifer sampling program completed 1980s Limited I-129 sampling</p>	<p>1983 Nuclear Waste Policy Act of 1982 passed; nine potential sites identified 1984 Environmental assessments drafted 1985 Nuclear Regulatory Commission comments on environmental assessments additional comments address I-129 1986 Final environmental assessments issued; three sites recommended and approved 1987 Legislation passed eliminating Hanford as a potential site for the repository</p>

Studies Through the 1960s

Preliminary work began on I-129 and other radionuclide detection equipment and laboratory methods development in the late 1950s and early 1960s. The collection of Hanford groundwater samples for I-129 environmental analysis was initiated in 1962. During the 1960s, some analyses of both on-site and off-site samples were made for I-129. However, no major reports summarizing the results were prepared.

1972 Report on Hanford Well-Water Samples

In 1971, the Atlantic Richfield Hanford Company (ARHCO), a principal AEC contractor at Hanford, initiated a study to determine radionuclide concentrations in the groundwater near the eastern perimeter of the Hanford reservation. This study was the result of concern about potential off-site migration of contaminants generated from Hanford operations through the confined aquifer systems. The intent of this study was to provide additional insight into the ultimate fate of nuclides moving eastward with the groundwater toward the Columbia River.

A report on this study was released in December 1972.¹ I-129 was the primary radionuclide measured, although other groundwater tracer elements were measured for comparison and correlation purposes. ARHCO concluded that the results of the sampling made during this study, as well as data acquired earlier (1962-68), indicated a strong possibility that radioactivity from Hanford operations was entering certain confined aquifers and moving eastward beneath the Columbia River.

This report was initially classified but was declassified with deletions on February 13, 1973. However, in a letter to AEC-Richland dated June 7, 1973, ARHCO confirmed discussions with AEC-Richland on the status and proposed expansion of this study. As a result of these discussions, it was decided that until further information was obtained on the possible source of the groundwater contamination and its possible biological hazard, all information should be limited to those individuals who have a need to know. In August 1987, DOE stated that it had found no AEC response to the proposal for this particular work.

¹Radiochemical Analyses of Hanford Well-Water Samples (BNWL-CC-1800 83, June 16, 1972, F. J. Brauer and H. G. Rieck, Jr.).

1975 Brauer-McFadden Report on Water Samples

In June 1975, a draft report was prepared which contained information on Hanford water sample analysis between 1962 and 1974.² This report contained extensive testing results data and since 1985 has been referenced as an I-129 baseline document. The report concluded that a thorough understanding of potential contamination pathways was essential because (1) groundwater movement was evident and (2) contamination may possibly have penetrated the basalt layers and entered the deeper confined aquifers. However, additional sampling and monitoring were needed to obtain more details on present and potential movement of the radioactive contamination. The draft report was provided to DOE's predecessor agency, the Energy Research and Development Administration (ERDA), for review and comment in August 1975 at approximately the same time it was sent to ARHCO. However, the report was not released as a formal draft until December 1986—11 years later. According to officials at Hanford, the report was not released or published earlier because (1) the report was not prepared in response to a funded request by a specific client; (2) the data had been transmitted and a contractual responsibility fulfilled; and (3) the review or clearance process became too time consuming, thus making the document not worth publishing. This report was never classified, although some contractor personnel had thought that it was classified.

CASP Program

As a result of early off-site irrigation well data, the CASP program was initiated in about 1975. This work included completing 13 boreholes on the Hanford site, for the most part down into the Mabton interbed (a sedimentary interbed between the basalt layers located at a depth of about 1,200 feet below ground surface). (See fig. 1.2.) The Mabton interbed was apparently thought to contain radioactive contaminants from the Hanford reprocessing facilities, which could cause it to act as a conduit for off-site migration of the contaminants to the east and south-east. The stated concern was that the Mabton interbed water was used for irrigation of farmland adjacent to the Hanford site and if there was intercommunication between the unconfined and confined aquifers, there could be a pathway for radioactive contaminants to uncontrolled public waters. One aspect of the CASP study was the off-site migration study; another was the limited intercommunication study of the upper confined aquifer in the vicinity of two ponds near the reprocessing facilities.

²"¹²⁹I, ⁶⁰Co and ¹⁰⁶Ru Measurements On Water Samples From The Hanford Project Environs 1962-1974," F. P. Brauer and K. M. McFadden, June 1975.

The wells completed in the Mabton interbed were sampled during the CASP period (approximately 1975 to 1980) to assess migration rates of I-129. No reports summarizing or analyzing the CASP information were written or published and for the most part, the I-129 and related data obtained under the CASP study were unreleased and/or unpublished until August 1987.

1976 ARHCO Technology Plan

In October 1976, ARHCO revised and updated a Technology Program Plan (ARH-CD-431) covering fiscal years 1977 through 1983. Included in this plan were efforts to respond to ERDA program needs for environmental control technology and national waste terminal storage. Under the National Waste Terminal Storage Program, several types of geologic formations were identified as potential terminal storage sites, one of which was the basalt flows underlying the Hanford facilities. The plan was to determine the technical and environmental feasibility of providing safe terminal storage within deep basalt deposits underlying the Hanford facility. Among the plan's objectives were (1) documenting the area's historical tectonic (structural) stability; (2) defining major faulting; (3) determining the location, thickness, slope, and physical properties of the discrete basalt layers; and (4) identifying the various aquifers along with the extent of their interconnection, recharge, and discharge locations.

The ARHCO plan also included several hydrology programs to address (1) the flow patterns of unconfined and confined aquifers, (2) groundwater movement and radionuclide transport, (3) water sampling for I-129, (4) migration pathways of radionuclides, and (5) hydrologic and pump testing. Most of these programs were scheduled to be completed between 1977 and 1983.

In commenting on this program, DOE stated that technology program plans were prepared each year for several years. Each would delete the past year and add an additional year—completing as much work as could be done with available funding. During that period, a number of wells were drilled and testing and sample analysis of water from the wells included I-129. Results and documentation of the drilling, testing, sampling, and analyses related to these projects were not published or referenced until August 1987.

**Studies and Reports in the
1980s**

Monitoring activities and studies in the 1980s focused on analysis of data from the unconfined aquifer, with very limited drilling or sampling of the confined aquifer system for I-129. Few reports about I-129 studies were written and even fewer were published.

**DOE Did Not Disclose
Information About I-
129 In Hanford
Groundwater**

Figure 2.2 shows a summary of events related to disclosure of the studies and reports on I-129 in Hanford groundwater. We did not find evidence that the information was withheld because of a deliberate policy decision on the part of DOE or its contractors; however, we did find a pattern of activity regarding the handling of information on I-129 that inhibited or suppressed the disclosure of information. This pattern of activity was apparently influenced by a variety of factors which include classified matters, concern for public reaction to information that might be perceived to have an effect on environmental and health and safety issues, and Hanford as a potential repository site.

**Rockwell Scientist
Attempts to Pursue I-129
Issue**

Late in 1983, a scientist working in the Environmental Protection Department of Rockwell Hanford Operations (Rockwell had succeeded ARHCO), whose responsibilities included examining Rockwell's groundwater compliance program, became concerned about I-129. Specifically, because I-129 releases to groundwater were not being monitored, he was concerned about a potential violation of regulatory standards which control radiation exposure to workers, the public, and the environment. Figure 2.2 gives the scientist's description of the events that occurred subsequent to his arrival at Hanford in September 1983.

The scientist made inquiries about the primary source of I-129, which was liquid effluent from the reprocessing facilities at Hanford and requested funding to develop a monitoring system for I-129. Rockwell management informed him that sufficient funds were not available and such a system was beyond the scope of his responsibilities. Consequently, the scientist used funds from another account he controlled to cover initial development work on establishing analytical procedures to measure I-129 from the liquid effluent.

In March 1984, the scientist's manager requested that he prepare a presentation for an effluent and environmental controls topical meeting. These meetings were associated with a technical exchange program among DOE and contractor personnel and were held quarterly for Hanford site staff to discuss topics of interest to Hanford. Before making his presentation, the scientist obtained his department manager's approval

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Figure 2.2: Summary of Events Related to I-129 Disclosure

Date	Event
April 1984	Scientist assigned to monitor groundwater compliance presents a program on I-129 to other Hanford scientists. Hanford officials reportedly criticized him for making the presentation.
April 1985	NRC's on-site representative obtains a copy of the 1975 report on I-129 testing.
May 1985	On the basis of information provided by the NRC on-site representative, DOE Richland officials ask DOE's Office of Inspector General to determine if there had been an attempt to conceal information about I-129. Investigation by Office of Inspector General conducted in May and June 1985. DOE's operating contractor recommends establishing a team to study the I-129 issue.
October 1986	DOE's operating contractor issues memoranda clarifying how information is to be shared with NRC.
November 1986	Intercontractor Working Group established to address the concerns that not all of the known I-129 data had been centrally available in an identifiable manner and also to recommend future directions for I-129 work.
April 1987	Office of Inspector General issues report concluding that information had not been deliberately withheld. Intercontractor Working Group's focus reduced to assessing available I-129 information. Washington State requests all I-129 documents gathered by the Intercontractor Working Group.
May 1987	Intercontractor Working Group issues draft report for management review.
August 1987	Intercontractor Working Group issues final report concluding that current amount of information is insufficient to draw conclusions about the movement of I-129 in groundwater.
September 1987	Washington State received the last of I-129 documents requested in April.

of a proposed outline and practiced his presentation sessions with his immediate manager and department manager.

In April 1984, the scientist made his presentation at the technical exchange program. His presentation included not only information on I-129, but also on such other topics as toxic organic wastes, nitrates, and technetium. At a question and answer session immediately following the presentation, the scientist was challenged on a few minor points and responded to them. The following day, according to the scientist, a DOE

official called him and accused him of disseminating false information because of an error in a slide showing unconfined aquifer volume. The scientist considered this a minor point which did not seriously affect the accuracy of his presentation. The scientist stated that the DOE official also told him that DOE did not want any I-129 studies made that were associated with Hanford's reprocessing facility.

According to the scientist, after the presentation he heard rumors that a DOE-Richland official had called Rockwell's General Manager and demanded that the scientist be fired. The scientist said he did not attach much significance to the alleged threat because it was hearsay and he could not confirm it. He further stated that he was not instructed to stop working on the I-129 project.

As a followup to his presentation at the technical exchange meeting, the scientist, with the assistance of other staff involved in research and development and chemical engineering, prepared a proposal oriented toward treating liquid waste effluent from the reprocessing facility. The proposal was approved by senior Rockwell management, routed to DOE-Richland, and sent to DOE's Hazardous Waste Program office at its Oak Ridge National Laboratory. Subsequently, according to the scientist, there was another reaction similar to that which occurred after the technical exchange meeting. He said that DOE officials were disturbed at the project's proposal because it mentioned some of the contaminants in the liquid effluent, and they were concerned that this information could be made public knowledge.

According to the scientist, he believed at this point that he was totally ineffective in his position and, accordingly, began searching for employment elsewhere or a transfer within Rockwell. In September 1984, he transferred to another Rockwell department at Hanford. He stated to us that no one directly pressured him to take such action.

NRC On-Site Representative Inquires Into I-129 Issue

In early 1985, NRC's on-site representative at Hanford learned about and started making inquiries into the usefulness of I-129 as a groundwater tracer. He also made inquiries into past DOE activities to monitor the radionuclide in the environment on and off the Hanford site. He said that information obtained from these inquiries indicated that groundwater from Hanford had migrated in a confined aquifer system under

the Columbia River to farm irrigation wells east of the site. The NRC representative concluded that this information might be pertinent to understanding the hydrology and groundwater travel time from the proposed repository location to the accessible environment.

During the NRC representative's pursuit of the I-129 issue, he learned about the following earlier events, or the events that occurred after he began his inquiry.

- In April 1984, the Rockwell scientist was criticized, as discussed earlier, for his presentation at a technical seminar on monitoring I-129 in Hanford groundwater. DOE had restricted the NRC representative from attending this seminar. Site-specific agreements between DOE and NRC on procedures for information exchange and consultation during site investigation and characterization at Hanford were not completed until September 1984 and later.
- In March 1985, NRC submitted its initial comments on DOE's draft environmental assessment of the Hanford site in support of the selection process for the first high-level waste geologic repository. NRC questioned DOE's estimates of groundwater travel time because of limitations of the data used. NRC recommended that DOE thoroughly reexamine the available information and that further support should be provided if the findings presented in the draft assessment were going to be sustained.
- In April 1985, the NRC representative obtained a copy of the 1975 Brauer-McFadden report on I-129 and showed it to various Rockwell and DOE employees working on the repository project with responsibility for the groundwater travel time determination. Reactions to the report and the I-129 issue were mixed—some did not know about the report or the information on I-129; others wanted a copy of the report and tried to find out where the NRC representative got the 1975 report; and some raised the question of whether the information was classified for security reasons.
- In May 1985, DOE-Richland referred to the Office of Inspector General allegations—which were based on information provided by the NRC site representative at Hanford—that (1) a Rockwell employee had been administratively disciplined for discussing at a technical seminar in 1984 the possibility that radioactive nuclides, and specifically I-129, produced on the Hanford site by the site's processes, were migrating to the aquifers located beneath the site, and (2) information was withheld about I-129 in aquifers located beneath Hanford and adjoining farmland. The subsequent investigation, conducted in May and June 1985, did not

substantiate either allegation, according to the Inspector General. However, the Inspector General's report on the investigation was not issued until April 1, 1987—almost 2 years later.

- In June 1985, NRC informed DOE headquarters that subsequent to providing comments on the draft environmental assessment on March 20, 1985, it had learned of data that might be relevant to estimates of groundwater travel time at Hanford. The data included measurements of long-lived radionuclides, like I-129, which might be of use in inferring groundwater behavior in the basalt formations near where the nuclear waste might be emplaced. The report obtained by the NRC site representative was mentioned in this letter, and NRC suggested that DOE consider the data in responding to NRC comments on the draft assessment. NRC also suggested that DOE consider the circumstances that led to the absence of a reference to this document from the draft environmental assessment.
- In a memorandum dated October 13, 1986, the Manager of Rockwell's Hydrology Group for BWIP issued a directive prohibiting any communication with NRC without DOE's prior approval. The memorandum added that violation of the directive may result in immediate dismissal. On October 17, 1986, the Associate Director, BWIP/Rockwell, issued a memorandum stating that the record needs to state, relative to interface with NRC, that (1) all communications with NRC are to be in accordance with the procedural agreement between DOE and NRC, (2) DOE is to be informed of any internal correspondence given to NRC, and (3) project management needs to be kept informed of information transmitted to NRC; however, there has never been any intention to dismiss staff for talking to NRC and/or responding to NRC requests.

As requested, we inquired into the latter event to determine if DOE or senior contractor management had ordered data withheld from NRC or if the manager was relieved of his managerial duties as a result of the incident. Although we did not find evidence of either contention, the event does illustrate the pattern of activity at Hanford that resulted in restrictive disclosure of information within the Hanford community and to the general public. During our review, we also learned of an October 1982 incident in which another contractor manager had issued a memorandum on dealing with outside agencies. The manager stated in this memorandum that if he ever found anyone going to DOE or the NRC who made statements relative to differences in views between management and technical staff, he would take action to terminate that person immediately. Contractor management told us that this incident was not directly related to the repository or I-129 issues but involved general problems that employees were voicing outside company procedures for resolution.

Intercontractor Working Group on I-129

After the NRC site representative's initial disclosure of information about I-129 in Hanford groundwater, Rockwell made a brief review and assessment of allegations and questions concerning the issue. The results of this effort left several unanswered questions and in May 1985 Rockwell recommended that a DOE/multicontractor team be established to investigate the matter further. These results and recommendation were also discussed with DOE-Richland in May 1985. Although Rockwell subsequently took several actions, such as developing an action plan, gathering and assembling data from the CASP study, and addressing NRC comments on the draft environmental assessment concerning lack of I-129 data in the assessment, an intercontractor working group was not actually established until November 1986. This date is about 6 months after DOE issued the final environmental assessment on the Hanford site.

According to DOE, a few Rockwell technical staff were concerned that not all known data on I-129 had been made available in an identifiable manner and in a central location. The working group was formed and funded by Rockwell to gather and certify such data. The group was comprised of recognized senior scientists from Hanford contractors in the fields of soil and hydrochemistry, soil science, and laboratory analysis to look at the past data and processes used to obtain the data and determine what data could be used. DOE had no formal role in the formation, organization, and objectives of the working group; however, all results have been made available to DOE, and DOE has taken part in all subsequent activities.

According to a member of the working group, the group's original charter went beyond gathering, cataloging, and summarizing information on I-129 to include making interpretations and providing recommendations concerning present and future activities at Hanford. The purpose and objectives of the group were modified, however, as the result of meetings among the chairman of the group, Rockwell management, and DOE officials in April 1987. DOE and contractor officials told us that this change in the charter was an effort to refocus the work back to what management had originally intended and try and accomplish as much as possible with the limited resources available. This modified, reduced scope of the working group was presented to the state of Washington on April 17, 1987. At this meeting, the state requested all documents that the working group had gathered. As stated in its final report, the working group was assigned to gather, summarize, and evaluate information available on I-129 in the Hanford site groundwater. The intercontractor working group's objectives were to

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- gather and integrate available data and related information about I-129 in groundwater beneath and surrounding the Hanford site into a simple data base;
- determine the availability, credibility, and reliability of I-129 data and suggest the approach for future data needs;
- determine if other isotopes, such as tritium (^3H) and technetium (^{99}Tc), which have similar migration characteristics, need to be considered in parallel with future I-129 considerations;
- review the sources of I-129;
- evaluate I-129 and associated data and place them in perspective for decision-making;
- identify unissued documents, data, and/or work that should be completed or published to further enhance the I-129 data base;
- enumerate technical data issues and suggest direction if appropriate; and
- be alert to potential security issues.

A draft of the working group report contained a section on management observations that was deleted from the final report. Included in this deleted section were the following observations:

- Overall integration and control of the long-term environmental issue and activities for the “whole of Hanford” was not clear and crisp. The separate programs and contractor responsibilities for environmental control, monitoring, and use of the Hanford Site resource need to be integrated. An even earlier draft stated that, “. . . Little evidence was found of integrated planning for overall site management and protection.”
- Discovery of numerous important activities and publications that were started but not completed. Sometimes, it was obvious that funding had evaporated. Other times, reasons for stoppages of work were not evident. There were examples of reports not published, but the reports and data were referenced. An earlier draft stated that, “Documents appear to be written without direction or purpose, and many do not get published, but get referenced.”

In a May 22, 1987, memorandum transmitting the draft report to Rockwell management officials for review, the chairman of the intercontractor working group called attention to the section on management observations and stated that, “. . . You may not like it—but there are truths in it.”

The working group published its final report, "Data Compilation: I-129 in Hanford Groundwater" in August 1987. Its findings were the following:

- There are about 2,900 on-site and off-site monitoring wells, of which 1,100 have been used for groundwater sampling of confined and unconfined aquifers. The remaining 1,800 wells are used for other types of monitoring.
- Approximately 210 wells have been sampled for I-129—about 175 in the unconfined aquifer and approximately 35 in the confined aquifer system.
- Most confined aquifer sampling was conducted before 1980 and was at a depth of 1,200 feet. Limited I-129 samples have been collected in the confined aquifers on-site since 1980 or in aquifers below 1,200 feet.
- Current I-129 analytical methods have detection sensitivities approaching natural background levels that existed before 1944; however, the techniques used in collecting some of the samples were inadequate to support the detection sensitivity of the analytical methods.
- Analytical results for approximately 700 sampling events were reviewed, and general qualification statements were developed for the user of the data.
- Most I-129 data from the unconfined aquifer appear to be valid.
- No applicable regulatory standards currently appear to be exceeded.
- I-129 was detected above background levels in the confined aquifer system to a depth of approximately 1,500 feet.
- The occurrence and distribution of I-129 in the confined aquifer appear to be localized in the vicinity of geologic fracture zones.
- Some of the confined aquifer I-129 data were acquired with questionable drilling and sampling techniques that may invalidate the analytical results. The data may be useful for planning purposes, but they do not meet quality assurance program documentation requirements.
- There were conjectures that I-129 in the Hanford groundwater resulted from possible injection of liquid nuclear waste into the aquifers. No evidence could be found to support this hypothesis even though there is documentation that radioactive waste had been discharged into the unconfined aquifer and the zones above it.

Conclusions reached by the intercontractor working group were as follow:

- All recent on-site and off-site measurements of I-129 complied with criteria requirements of applicable regulations.

- Although elevated (above background) I-129 levels in well samples from east of the Columbia River were comparable to levels found 50 to 200 miles from the Hanford site, further studies are needed to confirm how it got there and where it came from.
- There is an insufficient volume of I-129 data from the confined aquifer system to draw definitive conclusions about I-129 movement. Current programs should further develop the I-129 data base with new information that will meet necessary quality standards to allow definitive conclusions.
- Other radionuclides that have transport characteristics in soils and groundwater similar to I-129 should be further examined.
- The implementation of water and effluent mass balance (accounting for total waste produced) in site waste management and environmental monitoring and control would greatly enhance data base information and improve the site modeling efforts.

The state of Washington, in a special investigative report prepared by its I-129 task force, found that an important section offering self-criticism in the draft Data Compilation Report was omitted in the final version. The state concluded that the scope of the working group was narrow, resulting in many of its task force's questions (and originally the questions of the group) remaining unanswered. It added that a system needs to remain in place to ensure follow-through of all recommendations and questions made by the working group and the state's task force.

Subsequently, Westinghouse Hanford Company's³ Manager, Defense Waste Management Division, in September 1987, formed a committee to (1) review Hanford's groundwater monitoring program and information status and (2) make recommendations regarding a comprehensive long-range groundwater analysis and evaluation program. The committee was composed of high-level local Westinghouse managers, an advisory engineer, and a principal scientist. To be included in the committee's analyses were

- a review of intercontractor working group recommendations on I-129 as they relate to the data base and groundwater monitoring program and

³On June 29, 1987, Westinghouse Hanford Company assumed management responsibilities for all major DOE defense and energy programs at Hanford formerly managed by Rockwell and several other contractors.

- an assessment of data in the working group's report to assure that appropriate information is incorporated in ongoing characterization and monitoring activities within waste management programs.

In February 1988, DOE-Richland and Westinghouse-Hanford officials told us that a report was planned but had not yet been issued.

Security Issues Affected Availability of I-129 Information

The issue of security and the ready availability of I-129 information at Hanford were closely interconnected. Security issues, real or perceived, played a role in restricting the availability of I-129 information to Hanford contractor personnel working on the repository project.

We found that much of the I-129 information, especially from the earlier (1950s) years of Hanford operations, had initially been classified. Subsequently, some of this information was declassified, but this did not necessarily result in its being available to the public, or to personnel working on the repository project. In fact, some of the declassified documents remain under the same physical controls as classified documents.

Uncertainties Over Security Status Causes Problems

Mixed opinions were reported as to whether I-129 information was classified. For example, DOE-Richland officials said that there were no security issues related to total volumes of I-129 produced at Hanford. However, in a November 1987 report, Washington State Department of Social and Health Services' Iodine-129 Task Force, stated that DOE, the intercontractor working group, and contractor representatives said that care had to be taken in ensuring that no possibilities existed for tracing I-129 measurements to the reprocessing activities because it could be used to determine total nuclear material production. They said the original work on I-129 was not done for DOE but was done to use I-129 as a tracer to source (e.g., nuclear weapons testing), and early methods of doing this, which were developed at Hanford, were classified. They further reported that currently, environmental data on I-129 are not classified but that any indication of the total I-129 produced at Hanford could indicate nuclear material production rates and must remain classified.

DOE contractor staff working on projects addressing I-129 were made aware that they could be facing security issues. For example, one objective of the intercontractor working group study of I-129 was to be alert for potential security issues. Several contractor staff told us that confusion and uncertainty exist over the security status of I-129 data. For example:

- A contractor official told us that analyzing effluent or air samples for I-129 was previously classified because the measurement of I-129 was used to detect atmospheric nuclear testing. He said the previous security classification of some I-129 data may have created a “mind set” in some people that all I-129 information was classified. He also said that security concerns may have been the reason behind the incident, discussed earlier, involving the Rockwell scientist’s April 1984 presentation.
- A contractor project engineer said that his manager favored obtaining more I-129 data, but this was not looked on favorably by higher management. He said it may have been because some of the I-129 data were classified. He believed that PNL, Rockwell, and DOE management were reluctant to obtain more I-129 data, seemed very sensitive to the issue, and that security always seemed to be an obstacle.
- The NRC on-site representative reported that in April 1985, he obtained a 1975 document which contained I-129 data. This draft was marked “Draft Copy—Not for Distribution.” He reported further that the DOE classification officer told him the data should not be classified, yet the Rockwell BWIP Director told him it was classified and a number of the BWIP staff still treated the information as classified. A contractor hydrologist said that the information could have been added to BWIP’s hydrochemical data base and helped in their understanding of the groundwater flow system at Hanford. When BWIP staff subsequently tried to get a copy of the report from PNL, they were told the information was classified, was not to be released, and could not be talked about on the telephone.
- A member of the intercontractor working group told us that Rockwell management became suspicious of him because they believed he was getting too involved in classified information. He said that he was accused of obtaining classified documents for which he had no documented need to know, was interrogated by the Rockwell and PNL security offices, and was required to take a psychological profile examination.

**Declassified Documents
Still Under Security
Control**

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In May 1985, the NRC on-site representative reviewed the card catalogue at PNL’s technical library for subject matter on I-129. He listed 68 documents, 30 of which were identified in the catalog as being classified either secret or confidential. The representative told us that he did not examine or request any of the classified documents.

We examined the documents identified as classified and determined that 21 of the 30 had been declassified—one as early as 1957, two as late as

October 29, 1987—2 days after we began our examination. All 21 documents had been issued in the 1950s.

The declassified documents and the card catalog identifying these documents were kept in the secured vault at the library even though they no longer required secure handling. According to a PNL official, a person would have to obtain a DOE security clearance in order to be admitted to the vault, and declassified documents would be made available to persons who identified and requested them only if the documents had been publicly released. Because a security clearance was required to gain admission to the vault, however, it required, in effect, a security clearance to identify and gain access to declassified data.

According to the PNL official, the library had neither the shelf space nor the staff to prepare catalog cards and reproduce declassified documents and place them in the library's unrestricted reading room. The library has also been releasing declassified documents to the public according to the official. For example, in 1986, DOE-Richland released about 19,000 pages of environmental data collected over 40 years of Hanford operations, much of which had formerly been classified.

Declassified documents are sent to DOE's Office of Scientific and Technical Information for addition to the DOE Energy Database. If the Office had no objection to unlimited distribution, it would release the documents to the National Technical Information System, a fee-for-service system of the U.S. Department of Commerce. To determine if the 21 declassified documents we reviewed were available to the public through the DOE Energy Database or the National Technical Information Service, we accessed both services on November 18, 1987, and found that six of these documents were available through the DOE Energy Database and four through the Service. Three documents were in both databases.

Classified I-129 Documents Tightly Controlled

Classified I-129 documents were kept in the secure vault at PNL's technical library and required a restrictive "need to know" before they could be examined. To gain access to the documents on the NRC representative's list that were still classified, we had to have our "need to know" authorized at the DOE Deputy Assistant Secretary level.

The documents gave us a better understanding of how I-129 got into the air, soil, and aquifers at Hanford. These documents, however, did not

indicate that I-129 was present in the deep confined aquifers at or about the depth where the proposed nuclear waste repository would be built.

DOE Position on I-129 Issue and Selection of Hanford as a Candidate Repository Site

The environmental assessment on Hanford as a candidate site for the first high-level radioactive waste repository was issued by DOE in May 1986. In responding to NRC's comments on the draft assessment, DOE stated that available I-129 data may or may not be suitable for use as a *man-made tracer to assist in flow system conceptualization or evaluation of groundwater travel times*. To assess the potential use of these data, DOE said it would carry out a technical review to evaluate published and unpublished I-129 information. The support role I-129 data might have in addressing groundwater travel times, DOE said, must await completion of this review. DOE also discussed additions of several referenced materials regarding I-129 at Hanford to the assessment.

DOE-Richland and contractor officials at Hanford told us that I-129 information was not included in the draft environmental assessment and only briefly discussed in the final assessment because DOE headquarters only allowed information that had been published—and hence was referenceable—to be included. However, a DOE headquarters official told us that he was unaware of any policy or guidance requiring that documents be published before being included in the assessment.

In responding to this conflict in statements, DOE-Richland officials said that in gathering documentation for key reports such as the environmental assessment and the site characterization plan, it has been a DOE-Richland position, whether the guidance was in written form or not, that all references cited will also be available to the public. DOE-Richland has considered it proper to reference published documents and papers, and even papers that will become available in the near-term. Data and data packages can also be made available to the public and have been considered legitimate references. In general, proprietary and classified material is not referenced because it cannot be made available to the public. In those instances, the portions of the material considered relevant would either be declassified, or a nonproprietary, nonclassified version might be authored. From DOE-Richland's perspective, the I-129 material was not eliminated because of its classified nature. Upon learning of its availability and questions it might raise, an effort to declassify it for use was instituted by DOE-Richland.

A principal finding of the intercontractor working group report is that major portions of the unpublished I-129 data are questionable because

of inadequate drilling and sampling controls for determining low levels of I-129. The report advised that considerable caution is thus needed to avoid misleading and erroneous conclusions based on those data. Although DOE had no formal role in the formulation, organization, and objectives of the working group, DOE states that questions regarding the interpretation of such data and its relationship to the groundwater movement as described in the environmental assessment could be viewed as a catalyst for assuring the issue is addressed.

At the request of DOE, a technical services contractor reviewed the documents which provided information on I-129 at Hanford. (Note: these are the documents primarily assembled by the working group and requested by the state of Washington.) The objective was to address the potential effect of this information on the proposed underground high-level nuclear waste repository. The contractor's review identified nothing that would adversely impact the selection of the proposed repository. According to the contractor, the limited evidence available showed that

- I-129 by itself should not be used as a groundwater tracer.
- There is a lack of consistent and precise information on I-129 background activity levels for comparative purposes.
- The reviewed information indicated limited opportunity for intercommunication between the known contamination of the unconfined aquifer and the confined aquifers of the Columbia River basalts.
- The absence of I-129 in some wells indicates humanly induced contamination at selected sites rather than accelerated groundwater travel times.
- Sources of I-129 other than "on-site" sources may have contributed to above-background levels in certain wells.

In responding to questions we submitted, DOE officials maintained in January 1988 that the data gathered on I-129 have not changed the DOE conclusions as set forth in the final environmental assessment of May 1986.

State of Washington Views on DOE Treatment of I-129 Issue

In August 1987, the state of Washington prepared a report on consultation and cooperation with DOE in evaluating the Hanford site as a proposed nuclear waste repository. One of the examples that the state used to express its dissatisfaction was DOE's handling of the I-129 issue. The state's report noted that key information documenting long-standing problems with I-129 contamination of the confined aquifer was not fully disclosed in the draft environmental assessments, nor in the body of the

Chapter 2
DOE Not Diligent in Assuring That Issues
Involving Iodine-129 In Hanford Groundwater
Were Resolved and Disclosed

final assessment. The state also concluded that the final assessment comment-response document misleadingly portrays an NRC letter which questioned the lack of disclosure of I-129 problems in the environmental assessment.

Washington also stated that the environmental assessment for Hanford makes only cursory reference to I-129 contamination of the confined aquifer in its discussions of groundwater. The document acknowledges the presence of I-129 in one borehole in the Mabton interbed, but attributes this finding to bad sampling procedures. The document never reveals evidence of the many additional contaminated boreholes, nor does it discuss the implications should DOE subsequently rule out this explanation.

Washington also criticized DOE's lack of responsiveness to the state's requests for I-129 information. The state commented that DOE and its contractors have known about contamination of the confined aquifer for over 10 years, but these revelations were not volunteered at the time Hanford was selected as a repository finalist. This information is key, for it could point to serious problems in meeting standards for groundwater travel time. In addition, the presence of radioactive iodine indicates that rigorous environmental monitoring will be needed to determine what, if any, additional contamination is produced by repository activities. Despite the importance of this information to the state, tribes, and their citizens, DOE nevertheless withheld the documents on this subject. The state had to make repeated requests before DOE finally provided most of the relevant documents known to exist.

DOE maintains, however, that the process of collecting, cataloging, and copying the large number of documents was a major effort. The state first requested the documents on April 17, 1987. DOE responded by providing 11 documents in May, 184 in July, 315 in August, and 120 in September 1987. DOE claims to have provided 272 more documents than originally requested by the state. Only a few, which either did not exist or were not pertinent, were not submitted to the state.

As a result of the information obtained from the intercontractor working group, the state of Washington's Department of Social and Health Services, as the state's radiation control agency, began an investigation of the alleged I-129 contamination problem at Hanford centering on those areas within the purview of the agency. The areas investigated included health implications, source terms, pathways and monitoring activities, compliance with standards, communication and coordination

of information, environmental baseline data, and analytical methods and sampling procedures. Another major question related to possible movement of groundwater between the confined and unconfined aquifers and the related implications for the high-level waste repository siting decision.

In discussing communication and coordination in its report of November 1987, the agency commented that a review of the iodine reference documents revealed a historical problem with disseminating information at Hanford. Information flow to groups needing it was impeded in the past by, among other reasons, misunderstandings on security issues (real or imagined), feelings that the information was of no interest or value outside the organization doing the work, fear of misinterpretation or censorship, questionable quality of data, or a number of other reasons. Evidence of problems relative to these and other issues was observed by the intercontractor working group and included in its draft data compilation report but were deleted in the final report. Members of the working group believed it should have remained. A major factor contributing to suspicions that there have been coverups of I-129 data is that several major documents (e.g., environmental impact statements for other programs at Hanford) do not contain information about I-129. The state agency believes that implementation of the recommendations in its report should correct this misconception.

Findings and recommendations in the Washington State agency's report included the following:

- Based on data covering the period 1958 through 1986, no adverse public health impacts are expected from I-129.
- The extent, direction, and rate of movement of I-129 in the confined aquifers are not well characterized around the reprocessing facilities areas.
- The disposal and groundwater pathway of I-129 is not clear.
- The source of I-129 contamination in irrigation wells east of the river is not known.
- Continuity is needed for a follow-through of the intercontractor working group recommendations that were made in the report.
- The scope of the group's work was limited.
- The group's assessment of the traceability and credibility of data appears accurate.

In January 1988 a consulting firm, retained by the state's Department of Ecology, Office of Nuclear Waste Management, issued a technical memorandum summarizing its review of more than 600 documents and other summaries related to the I-129 issue at Hanford. This review was made to (1) determine whether the intercontractor working group data compilation report accurately characterized the data within the documents, (2) develop recommendations to DOE for areas of study during site characterization, and (3) address questions on the treatment of the I-129 issue in the environmental assessment.

The technical memorandum contained the following conclusions:

- The data confirm previous studies which indicate that there is a significant level of interaquifer communication between the confined and the unconfined aquifers. This could have an effect on repository siting because it may imply reduced groundwater travel times to the accessible environment and because this level of deep contamination might affect the integrity of a monitoring program for the repository.
- The environmental assessment did intentionally omit a significant amount of known I-129 data and was misleading in its conclusions that iodine distribution at Hanford was limited.

A series of recommendations were included in the memorandum for DOE to consider in its site characterization plan.

NRC Views

We asked NRC officials for their views about whether the I-129 information would disqualify Hanford from consideration as a waste repository site. They replied,

"Given the limited data base currently existing for the BWIP site and the resulting high uncertainty, a definitive judgment cannot be made at this time on the disqualifying factors for the BWIP site. The information to be gathered during site characterization is needed to make a definitive judgment."

Conclusions

• During the last 20 or more years, DOE conducted numerous studies aimed at determining the migration of radionuclides, including I-129, from Hanford operations. These studies were made because of the concern that radioactivity might be entering certain confined aquifers and moving eastward beneath the Columbia River. As a result of the studies, wells were drilled, water samples were collected and analyzed, data were compiled, and various reports were prepared. However, as the

intercontractor working group found, numerous activities and publications were started but not completed. There was also little evidence of integrated planning in overall site programs and contractor responsibilities for environmental control, monitoring, and use of Hanford resources.

In spite of this long-standing concern and the many related studies, DOE did not address the issue in its December 1984 draft environmental assessment of Hanford as a candidate repository site. When the NRC on-site representative learned of and started making inquiries about information on I-129 in Hanford's groundwater, many questions were asked concerning DOE's handling of the issue. One concern was whether there was a "cover-up" of information that, if it had been disclosed, would have disqualified Hanford as a potential repository site. DOE's position on the issue has been that the available information on I-129 is insufficient to draw any definitive conclusions with regard to its migration and therefore its use in estimating groundwater travel time from the proposed repository site to the accessible environment.

In our view, the important question raised by the recent I-129 information disclosure is not its sufficiency for drawing definitive technical conclusions. In this regard, both NRC and the state of Washington now generally agree that not enough is currently known about the I-129 situation to have eliminated the Hanford site from further consideration as a repository on that basis. The I-129 information, however, is directly relevant to the issue of groundwater movement beneath the Hanford Reservation, and that issue is recognized as the principal technical issue to be addressed in determining the suitability of the site for a repository. The more important question, therefore, is why DOE did not disclose information so relevant to a key siting issue in its environmental assessment. Drawing definitive technical conclusions is not the purpose of these assessments, but of site characterization. The environmental assessments were intended to provide a basis, using available information, for nominating and recommending candidate repository sites for characterization and establishing whether sites are suitable for characterization.

We found no evidence to indicate any improper motive on the part of DOE or its contractors in withholding the information; however, we found a pattern of activity regarding the handling of information on I-129 that inhibited its disclosure to the larger Hanford Reservation community and the general public.

Groundwater Studies That DOE Had Planned for Site Characterization

Before Hanford was eliminated as a waste repository candidate, DOE had been preparing to conduct extensive studies, costing as much as \$1.9 billion (1986 dollars), which it believed would indicate whether the site was acceptable or unacceptable as a repository. These proposed studies, known collectively as "site characterization," included (1) fluid analyses to detect the presence and amount of I-129 in aquifers beneath the reservation and (2) large-scale hydraulic stress tests. DOE, the state of Washington, and other parties involved in reviewing Hanford considered these tests critical in proving or disproving aquifer intercommunication beneath Hanford. If the tests had shown that the aquifers were interconnected, the Hanford site might not have been able to meet the requirement governing groundwater travel time. However, now that Hanford is no longer being considered as a candidate site, the tests will not be conducted. If, however, Hanford were to again be considered for a repository site, the groundwater travel time issue would need to be resolved as early as possible consistent with the technical requirements of site characterization.

I-129 Strategy

DOE developed a strategy (I-129 Evaluation Proposal, USDOE, 1987) for addressing I-129 issues in response to questions about the presence of I-129 in groundwaters of the deep confined aquifers at the Hanford site. The strategy described actions to be taken by DOE both before and during the drilling of exploratory shafts to examine the location more fully. The program sought to obtain data defining the amount of and extent of I-129¹ throughout the Hanford Reservation within the deep basalts, and to differentiate, as much as practicable, the possible sources of I-129 that may be present in the deep groundwater.

DOE and its contractors maintained that the presence of I-129 in groundwater samples from the Hanford Reservation did not in itself mean that the groundwater had been contaminated from waste sites on the reservation, or that intercommunication existed between aquifers. DOE pointed out that there are several possible sources of I-129 in the Hanford groundwater: (1) naturally occurring iodine in the deep confined aquifers, (2) groundwater infiltrating through the rock system from the unconfined aquifer, (3) contaminated water and drilling fluids introduced during past drilling, and (4) potentially contaminated water used during well drilling.

¹DOE's I-129 strategy includes analyzing water samples for other mobile radionuclides such as ³H (tritium) and ⁹⁹Tc (technetium), which if present along with I-129, suggests defense waste as a source.

DOE's iodine strategy paper recognized these potential sources for I-129 and suggested methods of differentiating among the possible sources. Even if analyses of isolated groundwater samples indicated the presence of I-129, however, the source may be difficult to identify. To provide more conclusive information on aquifer intercommunication and groundwater travel time, DOE planned to conduct large-scale hydraulic stress tests.

Large-Scale Hydraulic Stress Tests

Multiple-well hydraulic stress tests involve pumping water from a specific study zone in a well and measuring the fluctuation of water levels in other zones at several additional wells. If water levels in other zones are affected, then there may be an intercommunication among zones that is important in evaluating the requirement of groundwater travel time. Under this requirement, the proposed site is not acceptable if the tests demonstrate that groundwater can migrate from the proposed repository site to the environment accessible by humans within 1,000 years. Groundwater movement between aquifers under Hanford may mean that the site does not meet this requirement.

DOE's draft site characterization plan stated that the hydraulic stress tests can be used to obtain estimates of hydrological properties of the various basalt layers, such as the rate at which water is transmitted, the ease of water movement, and the volume of water affected by fluctuations in water levels within the aquifers. DOE planned to use information on hydrological properties in assessing performance goals of the repository.

Views of Affected Parties on Hanford Site Characterization

The state of Washington, the Yakima Indian Nation, the Confederated Tribes of the Umatilla Reservation, and the Nez Perce Tribe were designated as parties affected by the proposed Hanford repository. As affected parties, the state and tribes received federal funding to monitor the BWIP at Hanford.

Washington State

Washington State was very critical of DOE's program for studying Hanford as a possible repository site. Washington State Department of Ecology officials told us they tried to convince DOE that groundwater travel constitutes a "fatal flaw" in selecting Hanford as a repository site. They said DOE should determine whether this fatal flaw exists rather than spend over a billion dollars to go through site characterization and drill

exploratory shafts. State officials claimed that DOE did not want to look for the fatal flaw. The state believed that in view of all the potential flaws at Hanford, it never should have been selected as one of the final candidate repository sites.

Washington State pointed out that groundwater investigations are crucial to determining the performance of the Hanford site as a repository because, after repository closure, groundwater is the primary route for radionuclides to reach the human environment. The state believed that groundwater travel times quoted in earlier DOE reports had been over-optimistic and that DOE may have seriously misinterpreted Hanford geology and hydrology.

A paper prepared by Washington State's Office of Nuclear Waste Management stated that because groundwater investigations were the most crucial element of the site characterization program for Hanford, this portion of the investigation must precede the drilling of exploratory shafts which would disturb the deep groundwater system and destroy valuable perishable data. DOE's site characterization plan called for at least two large-scale hydraulic stress tests prior to drilling exploratory shafts, with a major objective of providing a baseline of data for future tests.

The Washington State paper reported that the proposed repository was located in an area of the Hanford reservation already heavily contaminated with chemicals and radionuclides. Therefore, Washington State officials wanted DOE to take samples for I-129 in four wells planned as part of the hydrology program to get additional information about confined aquifer groundwater travel time. However, DOE-Richland officials said they decided not to sample the wells for I-129 because they believed the amount of pumping required to take these samples would have had unacceptable impacts on the hydraulic baseline. The officials said that the I-129 strategy would allow a future opportunity to take these samples.

Washington State hired a consultant to review I-129 documents and other related summaries on the issue. As discussed earlier, the consultant generally concurred with I-129 testing procedures in DOE's I-129 evaluation proposal and with proposed studies for detailed chemical characterization of the confined aquifers at the Hanford site. However, the consultant provided a number of recommendations for DOE to consider, such as source of water for drilling fluids, large-scale hydraulic

stress tests for all major aquifers, and inclusion of other existing wells in the studies.

Indian Tribes

Representatives of the three affected tribes told us they have been using consultants to review nuclear waste issues. Before selecting Yucca Mountain as the one site to be characterized, the representatives said that a review of Hanford's site characterization plan had begun or was about to begin. The tribes' review of Hanford's plan had not yet been completed when Hanford was eliminated as a candidate repository site.

The Hanford on-site representative for two of the tribes said that because DOE needed to get as much information as possible from each well, Hanford's site characterization plan should have included tests for other trace elements in their water samples, not just I-129. The on-site representative said there are a number of trace elements that can easily be identified in each sample which can give information about interrelationships of aquifers.

NRC Staff Views

In response to our questions regarding possible disqualifying conditions at Hanford, NRC responded that not enough was yet known about factors that might disqualify Hanford as a repository site. NRC also said that it had reached agreement with DOE regarding the testing strategy to provide information about characterizing the groundwater flow system at Hanford. NRC staff considered that a 2-to 3-year program of surface-based testing and analysis would have been adequate to provide more definitive data relative to the key concerns.

Conclusions

In December 1987, when Hanford was eliminated from further consideration as a candidate repository site, the issue of groundwater travel time was still unresolved. DOE, the state of Washington, and other parties involved considered this to be a major issue in determining whether Hanford was suitable as a repository site. The state of Washington wanted DOE to conduct tests to resolve the issue before proceeding with a site characterization program that could cost as much as \$1.9 billion (1986 dollars). However, DOE maintained that conducting certain tests would have affected the results of other future tests.

Notwithstanding this conflict, DOE, the state, NRC, and other affected parties agreed that not enough was known concerning groundwater travel time to adequately evaluate this potential disqualifying factor

Chapter 3
Groundwater Studies That DOE Had Planned
for Site Characterization

and that additional testing and analysis was needed. DOE was preparing to conduct extensive studies at Hanford to address this and other issues; however, now that the Congress has directed that further investigative work for repository be limited to the site in Nevada, the studies will not be made.

If, however, Hanford were to again be considered for a repository site, we believe that the groundwater travel time issue would need to be resolved as early as possible to be consistent with the technical requirements of site characterization.

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